Massachusetts Strategic Envirotechnology Partnership

Fostering Innovative Technology through a
Unique Partnership between the
Executive Office of Environmental Affairs and the
University of Massachusetts

1999-2000 ANNUAL REPORT

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To the People of the Commonwealth:

During its sixth year of operation, the Massachusetts Strategic Envirotechnology Partnership (STEP) has achieved solid success in developing innovative technology-based solutions to environmental challenges across the Commonwealth. As a joint program between the University of Massachusetts (UMass) and the Executive Office of Environmental Affairs (EOEA), STEP has been effective in promoting and stimulating private development and investment in environmental technologies and in fostering a business and regulatory climate that encourages the commercialization of these environmental technologies.

More than 120 companies received some form of business, technical, or regulatory assistance from STEP during the past year. EOEA and UMass have collaborated through STEP to help early-stage environmental firms to commercialize their technologies, as well as assist mature industrial firms to develop approaches for improving environmental performance. This assistance has served as a national model for how government, industry, and a public university can work together to achieve significant environmental and economic goals.

This past year, UMass and EOEA completed a strategic planning process to further support and enhance STEP's future success, and the resulting STEP Strategic Plan provides a critical framework for carrying out the program during the next three years. Our intent is to leverage the wide-ranging resources within UMass and EOEA, to target those resources more carefully, and to establish the planning and communications systems needed to meet the increasing demand for STEP's services.

Furthermore, building on our successful collaboration through STEP, UMass and EOEA have signed an agreement to develop an expanded partnership in meeting the Commonwealth's environmental needs through research, education, and public service and in establishing an effective inter-organizational framework for managing those cooperative activities. We are confident that, in the future, STEP will benefit from the increasing cooperation between our two organizations.

We remain committed to expanding and improving STEP during the coming years and to using the program effectively to help meet the Commonwealth's environmental and economic goals.

With regards,

William M. Bulger
President
University of Massachusetts

Robert Durand
Secretary
Executive Office of Environmental Affairs

Massachusetts Strategic Envirotechnology Partnership

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STEP Highlights

"Through the STEP program, more than 120 companies with innovative environmental technologies received a wide range of business, regulatory, and technical services."

In 1999, in its sixth year of operation, the Strategic Envirotechnology Partnership (STEP) reached new levels of success in fulfilling its mission to develop and promote innovative technology-based solutions to environmental problems in the Commonwealth and, at the same time, to help grow the state's existing and new industries.

- Through the STEP program, more than 120 companies with innovative environmental technologies received a wide range of business, regulatory, and technical services, helping them accelerate the commercialization of their technologies.

- During 1999, STEP-assisted environmental companies succeeded in raising more than $8 million in private funding. Those companies included **AWT Environmental (New Bedford), CASTion (Ludlow), Ion Signature Technology (Cambridge), SelecTech (Taunton), SiteWatch (Milton), and SolmeteX (Billerica)**.

- The University of Massachusetts (UMass) System partnered with industry on more than 35 applied research and development projects during the past year, assisting the participating companies in developing, testing, and using promising technologies and techniques.

- Over 150 UMass students and faculty members participated in STEP projects, assisting UMass in meeting its educational mission.

- For every dollar that the Massachusetts Legislature appropriated to the STEP program in FY 1999, over three dollars have been leveraged in company contributions and outside financing, illustrating the program's value to the state's manufacturing businesses and startup companies.

- UMass and the Executive Office of Environmental Affairs (EOEA) completed the STEP Strategic Plan, which provides a blueprint for STEP during the next three years to become a national model of how government, industry, and a public research university can collaborate to achieve significant environmental and economic goals.

- As part of their ongoing collaboration through STEP, UMass and EOEA signed a memorandum of understanding to expand their partnership in several key environmental areas through research, education, and public service.

- Massachusetts collaborated with five other states – California, Illinois, New Jersey, New York, and Pennsylvania – to finalize a strategy for accelerating the reciprocal state acceptance of environmental technologies, thereby facilitating the potential commercialization of STEP-supported technologies outside the Commonwealth.

- The STEP program continued to participate actively in several critical state policy initiatives, completing a strategic plan to promote the use of recyclable materials in Massachusetts and contributing technical input to the development of the Renewal Energy Portfolio Standards.

STEP Mission

"UMass and EOEA have signed a memorandum of understanding to expand their existing relationship under STEP and develop an expanded partnership in several key environmental areas."

Established in 1994, the Strategic Envirotechnology Partnership (STEP) is a joint program between the University of Massachusetts (UMass) and the Executive Office of Environmental Affairs (EOEA) designed to:

- Promote and stimulate private development and investment in environmental technologies;
- Foster a business and regulatory climate in which innovative environmental technologies can thrive; and
- Stimulate the development and use of specific technologies that further public mandates of increased environmental protection and resource conservation.

Increased Collaboration between UMass and EOEA

UMass and EOEA have signed a memorandum of understanding to expand their existing relationship under STEP and develop an expanded partnership in several key environmental areas. The agreement specifies that UMass and EOEA have the "shared goal of increasing their cooperation in meeting the environmental needs of the citizens of the Commonwealth through research, education, and public service, and establishing an effective inter-organizational framework for the management of those cooperative activities."

As a result of the memorandum of understanding, UMass and EOEA have established an Executive Coordinating Committee and seven Environmental Working Groups that will review and plan cooperative education, research, and public service activities. The Environmental Working Groups will focus on the following areas: agriculture, biological conservation and ecosystem protection, community preservation, environmental technology, marine science and technology, pollution prevention, and watershed management.

Defining the STEP Vision: The Strategic Plan

This past year, UMass and EOEA completed a strategic planning process in order to support and enhance STEP's future success. The resulting STEP Strategic Plan describes the vision and goals for STEP during the next three years and, given the expanded partnership agreement between EOEA and UMass, discusses the ways in which these two institutions will work together in carrying out STEP.

According to the Strategic Plan, STEP "provides the infrastructure needed to plan, focus, and deploy the capacities in and resources of EOEA and UMass in a collaborative effort with Massachusetts-related industry to develop and promote innovative technology-based solutions to environmental problems in the Commonwealth that will help the state's existing and new industries."

Within the Strategic Plan, one of the key strategic goals for FY 2000 to 2003 is creating mechanisms to allow government and the private sector to evaluate and adopt technologies that have been developed with STEP assistance. The STEP partners also identified four areas of strongly shared priorities where STEP will focus its resources. These areas include: preventative, sustainable technologies; alternative/renewable energy technologies; assessment and monitoring technologies; and technologies that convert waste and scrap into useful feedstock.

STEP Partners

Executive Office of Environmental Affairs

"The effective partnership between EOEA and UMass has elevated STEP into a national model for developing and implementing new technology-based solutions to environmental problems."

The effective partnership between the Executive Office of Environmental Affairs (EOEA) and UMass has elevated STEP into a national model for developing and implementing new technology-based solutions to environmental problems. EOEA uses its participation in STEP as a unique tool to strengthen its policy-making and its technical and regulatory capacities and to enhance its ability to meet its mission and goals, as well as to implement priority environmental initiatives. Under the STEP Strategic Plan, EOEA has responsibility for regularly reviewing its list of priority initiatives and determining opportunities for technology-based solutions. In this way, EOEA ensures that STEP focuses on areas consistent with the state's environmental priorities.

Within EOEA, the Department of Environmental Protection evaluates state regulatory requirements to ensure consistent and fair regulatory treatment for innovative STEP-supported technologies and to facilitate permit reviews when appropriate. In addition, the Office of Technical Assistance for Toxics Use Reduction participates in assessing the merits of promising environmental technologies in meeting the state's environmental challenges.

This past year, EOEA succeeded in finalizing the STEP Strategic Plan in collaboration with UMass and, through a memorandum of understanding, expanded its ongoing partnership with UMass in several key environmental areas. In addition, EOEA played a critical role in working with the environmental agencies in California, Illinois, New Jersey, New York, and Pennsylvania to complete the document titled *Strategy for Reciprocal Acceptance of Environmental Technologies*, which will help accelerate the commercialization of STEP-assisted technologies outside Massachusetts.

University of Massachusetts President's Office

Within the University of Massachusetts (UMass) System, STEP represents the largest system-wide collaborative program. The President's Office has played an important oversight role in directing STEP within the UMass System and in ensuring close cooperation with EOEA. Every UMass campus has current capacity in a wide range of critical areas that support the STEP program, and each campus is developing additional capacity to assist STEP in its mission.

In FY 1999, UMass received a total of $2.75 million from the Massachusetts state legislature to support STEP activities at UMass campuses in Amherst, Boston, Dartmouth, and Lowell, and at their affiliated research centers. Over 150 students and faculty members throughout the UMass System participated in the STEP program.

STEP Partners

University of Massachusetts-Amherst

Center for Energy Efficiency and Renewable Energy

The Center for Energy Efficiency and Renewable Energy (CEERE) supported STEP by providing technology assistance to companies with innovative environmental, renewable and energy efficiency technologies. In addition, CEERE participated in numerous advisory groups as part of its efforts to offer technical support to state policy and regulatory personnel. Among these advisory roles, CEERE assisted in a major initiative to promote improved stormwater management. CEERE also undertook applied research projects with STEP-related funding from the Massachusetts Division of Energy Resources. These projects included CEERE's work on the Renewable Energy Portfolio Standards, as well as technical papers on wind energy, combined heat and power, energy efficiency, and other energy issues.

National Environmental Technology Institute

Through the National Environmental Technology Institute (NETI), UMass-Amherst researchers have worked with industry partners to research new designs and process modifications that minimize pollution in industrial operations upstream prior to ultimate treatment and disposal. NETI focuses on developing new technologies and techniques to reduce waste and prevent pollution through research partnerships between government, industry, and UMass. NETI's goal is to become a national leader in pollution prevention research, development, and technology.

University of Massachusetts-Boston

Environmental Business and Technology Center

The Environmental Business and Technology Center (EBTC) spearheads the identification and assessment of companies seeking STEP services from one or more of the participating state agencies and UMass centers. EBTC then provides business development services to these environmental and energy companies. One of EBTC's major contributions to STEP is to promote private investment in innovative environmental and energy technologies. EBTC's capital raising program has provided a unique opportunity for selected companies to present their business plans to a group of interested individual, institutional, and corporate investors.

STEP Partners

University of Massachusetts-Dartmouth

Advanced Technology & Manufacturing Center

The Advanced Technology & Manufacturing Center (ATMC) brings together Massachusetts firms and UMass-Dartmouth faculty members to conduct applied research on new technologies that are both environmentally and economically sound. For southeastern Massachusetts, ATMC serves as the regional provider of choice for advanced technology and manufacturing solutions for industrial problems. In support of STEP, ATMC conducted projects in a variety of applied research areas, including aquaculture, wastewater treatment, pollution detection, small sample preparation, renewable energy, and water information management.

In concert with MassDevelopment, UMass-Dartmouth has been planning to construct a 60,000-square-foot technology research and incubator facility for ATMC in Fall River. This building will provide a team of faculty, students, and technical staff, along with specialized facilities, to assist industries in southeastern Massachusetts.

University of Massachusetts-Lowell

Center for Environmentally Appropriate Materials

The Center for Environmentally Appropriate Materials (CEAM) focuses in STEP on promoting the transfer of environmentally sound materials technology to firms that are seeking to reduce waste generation. In addition, CEAM directs research projects on the identified needs of business and municipalities and maintains a literature library and database on new advances in the field.

CEAM also provides technical and policy advice on materials recycling, biodegradation, materials reuse, product design, and packaging selection. CEAM has teamed with UMass-Lowell's Toxics Use Reduction Institute to sponsor applied research projects on a variety of sustainable technologies.

Chelsea Center for Recycling and Economic Development

The Chelsea Center for Recycling and Economic Development has been working in STEP to create an infrastructure for a sustainable materials economy in Massachusetts. The Chelsea Center accomplishes this mission with support from the state's Clean Environment Fund by working with manufacturers, municipalities, and economic developers and other business service organizations. One of the Chelsea Center's main accomplishments this past year was the completion of the *Massachusetts Strategic Recycling Market Development Plan*. In addition, numerous manufacturers directly benefited from grants to develop, improve, or test recycled products, while others received assistance to introduce new or improved recycled products in the market.

Developing State Policies to Promote Technological Innovation

Both UMass and EOEA have used their significant technical and regulatory expertise to help establish innovative policies that promote the commercialization of environmental technologies within the Commonwealth; they have also undertaken critical studies that support these policies. As a result of these efforts, the Commonwealth of Massachusetts has emerged as a national leader in commercialization efforts for environmental and renewable energy technologies.

"Both UMass and EOEA have used their significant technical and regulatory expertise to help establish innovative policies that promote the commercialization of environmental technologies within the Commonwealth."

Improving Reciprocal State Acceptance of Environmental Technologies

EOEA worked closely with the environmental agencies of five other states – California, New Jersey, New York, Pennsylvania, and Illinois – to develop a report entitled *Strategy for Reciprocal Acceptance of Environmental Technologies*, which defines a common vision for speeding the interstate deployment of innovative environmental technologies. This report follows from a memorandum of understanding signed by the six state environmental agencies in June 1996 to define a process for the reciprocal evaluation and promotion of environmental technologies among the six states. Following the release of the *Strategy report*, Virginia became the seventh state to sign the memorandum of understanding.

According to the *Strategy report*, the participating states have identified a process based on common protocols that define data requirements for specific technologies. By assuring the use of the agreed-upon protocols in assembling the technology data, the states can make the results of their ongoing technology evaluation and regulatory approval efforts accessible to other states.

The participating states have proposed the establishment of a shared database of information about environmental technologies that have been tested according to the protocols. For both the states and the vendors, this type of reciprocity is critical in deploying technology at reduced costs, and it will accelerate the commercialization of those technologies developed by STEP companies.

Developing a Vision for Increasing the Recycling Market in Massachusetts

The Massachusetts Legislature mandated in late 1997 the creation of a strategic plan to promote the development of in-state markets for recyclable materials. EOEA selected UMass-Lowell's Chelsea Center for Recycling and Economic Development to oversee the strategic planning process.

In 1999, the Chelsea Center released the final *Massachusetts Strategic Recycling Market Development Plan*, which sets the course in Massachusetts for enhancing the state's capacity to identify and realize recycling market development opportunities. The Strategic Plan recommends a

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Developing State Policies to Promote Technological Innovation

Developing a Vision for Increasing the Recycling Market in Massachusetts

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broad range of cross-material, material-specific, and management system strategies for achieving that goal, and also identifies recycling market business opportunities that have the potential to serve as the focus for near-term recycling market development efforts. In addition, the Chelsea Center issued a draft memorandum of understanding regarding the roles of state agencies that have primary responsibility and involvement in the state's recycling market development.

Specifically, the Strategic Plan focuses on three primary ways for building the state's capacity to promote the development of the recycling market. First, the Plan encourages and supports market development across a wide range of secondary materials and recycled products by creating cross-material program tools in several key areas, including converting from virgin to secondary materials, developing and commercializing recycling technology, supporting existing recycled product manufacturers, and purchasing recycled materials.

Second, the Strategic Plan targets the identification and pursuit of material-specific opportunities; this effort includes assessing individual markets and selecting priorities. The third primary way for enhancing the state's capacity involves creating a management system for developing the recycling market. This management system would provide for consensus, coordination, and communication around four elements: market intelligence and assessment, strategic planning, program implementation, and program evaluation.

Establishing the Renewable Energy Portfolio Standard for the Commonwealth

Following the passage of the Massachusetts Utility Restructuring Act, the Division of Energy Resources (DOER) needed technical assistance in establishing renewable energy portfolio standard (RPS) rules for retail electricity suppliers selling electricity to end-use customers in the Commonwealth, and it looked to the Center for Energy Efficiency and Renewable Energy (CEERE) at UMass-Amherst to provide that expertise. According to the Utility Restructuring Act, DOER had to first determine the actual percentage of kilowatt-hours sales from existing renewable-energy generating sources to end-use customers in the Commonwealth, and then every retail supplier has to provide a minimum percentage of additional kilowatt-hours sales from new renewable-energy generating sources according to a specified schedule over the next several years.

CEERE has served as technical adviser to DOER's renewable energy team during the development of the RPS rules by preparing technical papers, providing expert input, and participating regularly in the RPS Advisory Group meetings. Specifically, CEERE has provided technical information on the history of renewable energy portfolio standards, the details and status of utility restructuring proposals in the various states and the federal government, and technical issues affecting policy choices for the RPS rules.

Research and Development Breakthroughs

Many of the companies in STEP's portfolio are consumer product or manufacturing companies that are working with UMass scientists, state regulators, and federal researchers to convert their products and processes into environmentally sustainable ones. For example, the largest of the STEP-supported programs, UMass-Amherst's National Environmental Technology Institute (NETI), provided $494,500 in funding for eight projects involving nine industry partners. These projects include the evaluation of technologies for achieving zero discharges in the textile industry and the development of molecular-level sieve membranes for ultra-fine separation.

Other campuses in the UMass system undertook similar efforts to achieve technological breakthroughs, such as UMass-Dartmouth's development of new biofilters for aquaculture applications, and UMass-Lowell's search for polyvinyl chloride (PVC) substitutes for IV and blood bags.

"The largest of the STEP-supported programs, UMass-Amherst's NETI, provided $494,500 in funding for 8 projects involving 9 industry partners."

Developing Environmentally Benign Industrial Processes

During 1999, NETI continued to explore environmentally benign methods for cooling the machinery in grinding operations, an essential process in precision manufacturing. Grinding traditionally uses liquid coolants to prevent thermal damage and premature wear of the grinding machinery, but these coolants present an environmental and health hazard.

NETI is working with several industry partners, including **General Motors, Norton Co., Torrington Co.**, and **SKF Technical Development Center**, in developing the new grinding methods. "We use a lot of coolants and lubricants, and there are a lot of environmental problems associated with those products," according to Steve Reder, senior application engineer at Torrington Co. "We're always trying to eliminate these environmental hazards, and even if you can change over a just few processes, it's a start."

NETI researchers have generated positive results through the use of a nonhazardous ester oil applied by a microlubrication gun, combined with cold air from a vortex-tube gun. This approach yields smoother surfaces than other approaches, and the researchers have extended the application to the grinding of hardened steels with a superabrasive CBN wheel. In the latest phase of the research, NETI and its industry partners are investigating the application of the technique to cylindrical grinding methods.

Increasing the Efficiency of Energy Storage Devices

With STEP support, NETI has also developed mathematical models to design and construct three experimental prototypes of elastomeric energy storage devices. The elastomeric materials have extremely high strain energy potential and rival flywheels, batteries, and high-pressure gas systems in many energy storage applications. "There are many ways to use this technology for improved energy management and substantial energy savings," according to Richard Farris, a pro-

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Research and Development Breakthroughs

Increasing the Efficiency of Energy Storage Devices

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fessor in UMass-Amherst's Department of Polymer Science and Engineering. "On a small scale, the devices could be used for mechanical batteries that could be charged far more efficiently by means other than the chemical batteries that are currently used," Farris notes. "On a large scale, elastomers easily have the potential to be used in regenerative braking for vehicles," he explains. "That is, instead of wasting the energy generated by friction brakes, you could store the energy using these kinds of elastomeric devices, and you could use this energy to reaccelerate the vehicle."

Finding New Uses for Recycled Rubber and Plastic

UMass-Lowell used STEP funding to launch new applied research in the area of producing new thermoplastic elastomers using recycled rubber and plastics. "Normally, elastomers are thermosets, and once you apply heat to thermosets, they set into a permanent shape that, by definition, cannot be 'recycled,'" according to Ross Stacer, professor of plastics engineering at UMass-Lowell. "What we are doing is putting a thermoset into a thermoplastic, which can be reprocessed by the addition of heat, and thereby create a new material that provides a reuse option for thermoset scrap."

UMass-Lowell researchers have blended recycled ground rubber with polypropylene to form a material that initially was thought to have applications in sports surfacing and flooring. "We have been able to improve the properties to the point where we can compete with virgin material and go into any application that a thermoplastic elastomer can, as long as the color black is not a problem," according to Stacer. "We have had a lot of responses from industrial companies for potential applications, and we have applied for two patents."

Industrial partner **Quabaug Corp. (North Brookfield)** will supply the UMass-Lowell researchers with excess thermoset material from the production of its Vibram sole material for footwear. "Our focus is on finding ways that we can put this material back into the process, by treating it in a way that allows it to be reused," says Michael Gionfriddo, Quabaug's vice president of operations. "We currently use about 10 percent of our scrap, and if we can increase that level by treating these materials, we can reduce our costs and become more environmentally friendly."

Advancing the Discipline of "Green Chemistry"

UMass-Boston's Environmental Business and Technology Center (EBTC), in collaboration with UMass-Lowell, supported John Warner, associate professor of chemistry and director of biochemistry at UMass-Boston, to conduct proof-of-concept research in the area of biodegradable photoresist materials. Photoresists are key components of the photocuring process in a wide variety of manufacturing industries, such as the paints and coatings, adhesives, photographic and graphic areas, and microelectronics industries.

"Current photoresist technology involves the polymerization of acrylate monomers–a highly toxic family of compounds that use volatile organic compounds and organic solvents," says Warner. "This new technology is entirely aqueous-based and nontoxic, and the material is immediately reprocessable, so there is zero waste." The photoresist materials developed to date under the initiative have been derived from biological mimics of DNA and RNA.

Overcoming Regulatory Barriers

"STEP provides environmental technology developers with assistance in understanding the regulatory and permitting requirements that their potential clients must meet."

Knowing the regulatory context in which an environmental technology must operate is critical in terms of tailoring the technology to the right market, speeding the commercialization of the technology, and ensuring that the technology itself complies with the regulations. STEP provides environmental technology developers with assistance in understanding the regulatory and permitting requirements that their potential clients must meet.

In addition, STEP assists environmental firms in developing reliable cost and performance data about their technologies, and the firms can then submit that data to regulators and clients. Regulators are key links in the technology commercialization chain because the permit conditions they impose on potential clients are based on the permit-writer's knowledge of the specific technology's capabilities – knowledge that STEP-generated data can provide. Clearly, customers need the cost and performance data in order to determine the most effective and least expensive methods of complying with their permit conditions.

Approving Closed-Loop Processes for Permitting Exemptions

When a technology eliminates the generation of pollution altogether, STEP assistance can help secure exemptions to the associated permit requirements, leading to lower compliance costs for the customer and a marketing advantage for the technology provider.

For example, during 1999, EOEA and the Department of Environmental Protection (DEP) evaluated the Controlled Atmosphere Separation Technology (CAST) industrial wastewater treatment process developed by **CASTion Corp. (Ludlow)** – formerly called Cellini Purification Systems – and determined that the process is a closed-loop system and is therefore exempt from Part B permitting requirements under the Resource Conservation and Recovery Act (RCRA). The CAST process recycles wastewater generated by a wide variety of metals-finishing processes, such as acid etching, electroplating, and galvanizing. "The RCRA exemption has proven to be a major competitive sales advantage," according to John Gannon, CASTion's president and chief executive officer. In addition, reciprocity agreements between Massachusetts and the six other states under the Seven-State MOU "have extended our RCRA exemption for the CAST system to these other states," says Gannon.

Another example of an innovative closed-loop treatment technology is the Effluent Management System (EMS) wastewater treatment system developed by **SolmeteX Corp. (Billerica)** to treat mercury-contaminated discharges from clinical laboratory analyzers. During 1999, DEP ruled that, because the EMS technology is a closed-loop system, its use does not require the user to obtain a RCRA Part B hazardous waste treatment permit. DEP's decision means that a laboratory director at a hospital or a medical center "can purchase the EMS system directly without needing to undergo the permitting process," says Owen Boyd, SolmeteX's president and chief executive officer. "The bottom line is, the hospital saves a lot of money."

Commercial Partnering Assistance

"There is no doubt that the STEP exercise helped us develop a more compelling commercialization pathway for our technology and significantly strengthened our proposals for enhanced prototype development."

Charles Kolb
President
Aerodyne Research, Inc.

During 1999, STEP expanded its efforts to provide commercialization assistance to Massachusetts technology companies that have received grants under the Small Business Innovation Research (SBIR) programs of the U.S. Environmental Protection Agency (EPA). Only one in four SBIR participants nationwide succeeds in commercializing their technologies within six years of receiving an SBIR Phase II grant to demonstrate a technology's commercial viability. STEP recognized that an SBIR company's chances of achieving commercial success will be enhanced if it receives a wider range of services early in the technology development process.

STEP teamed with the Massachusetts Technology Collaborative and EPA Region 1 to begin providing Commercial Partnering Assistance (CPA) to SBIR Phase I grant recipients. As a key element of the CPA program, STEP introduces SBIR firms to potential partners that could host demonstration projects, establish a joint venture with the grantee to further develop the technology, or license the process outright.

STEP began providing CPA assistance during 1999 to recipients of SBIR Phase I grants, which are used to demonstrate the technical feasibility of the concept. In 1999, the following six Massachusetts companies received SBIR Phase I grants: **Aerodyne Research, Inc. (Billerica); CeraMem Corp. (Waltham); E Paint Co. (East Falmouth); KSE, Inc. (Amherst); Physical Sciences, Inc. (North Andover);** and **Radiation Monitoring Devices, Inc. (Watertown).**

Finding Potential Partners

Aerodyne Research, Inc. (ARI) received a Phase I SBIR grant from EPA to demonstrate the feasibility of its Tunable Infrared Laser Differential Absorption Spectroscopy (TILDAS) instrument, a compact remote sensor for monitoring vehicle emissions through the use of lead salt diode lasers at near-room temperature.

"As part of our EPA SBIR Phase I project, we accepted STEP's offer to organize a presentation of ARI's technology to a gathering of representatives from leading companies in the automotive inspection and maintenance industry, as well as technical and policy personnel from DEP, the Executive Office of Environmental Affairs, and the Northeast States for Coordinated Air Use Management (NESCAUM) organization," says Aerodyne President Charles Kolb. "There is no doubt that the STEP exercise helped us develop a more compelling commercialization pathway for our technology and significantly strengthened our proposals for enhanced prototype development." As a result of STEP assistance, both **Keating Technologies, Inc.** and **Environmental Systems Products, Inc.** agreed to participate as partners in the next phase of Aerodyne's development work.

During 1999, STEP also provided commercialization assistance to past recipients of SBIR grants, such as **Foster-Miller, Inc. (Waltham).** Through the SBIR process, Foster-Miller has developed an environmentally friendly fluid for de-icing airplanes, but "ultimately, you have to get someone to agree to use it at an airport," according to Douglas Thompson, business development manager for Foster-Miller's Materials Technology Group. "Finding the right people requires a lot of organization, and for us to do that on our own, it's not impossible, but it's very expensive," Thompson says. "STEP put together the meetings and assembled the right people."

Product Testing and Verification

"I call the Chelsea Center all the time asking questions, and they respond."

Greg Conigliaro
President
Conigliaro Industries

Improving Client Confidence through Outside Assessment

A key element of STEP's service portfolio is the testing and verification of innovative environmental technologies. The road to commercialization of a new environmental technology involves convincing potential customers that the technology provides the desired level of performance at a justifiable cost.

More than ever, users of environmental technologies are applying stringent cost-benefit tests to the environmental technologies that they consider. Customers want to ensure not only that the technology fulfills the appropriate compliance objectives, but also that it goes beyond compliance to provide distinct economic benefits. Independent, third-party verification of a technology's cost and performance can provide a critical first step in establishing a market for the technology, and it can represent a significant competitive advantage for the developer.

During 1999, the STEP partners facilitated testing and verification projects for numerous Massachusetts companies, including **Conigliaro Industries (Framingham), Creative Paper, Inc. (Worcester), Dorchester Industries (Leyden), Recycline (Somerville), and SelecTech (Taunton).**

Recovering Useful Products from Hard-to-Recycle Materials

Several of the companies receiving testing and verification assistance specialize in developing new products made from scrap materials, including difficult-to-recycle materials or wastestreams that represent emerging disposal problems. For example, **Conigliaro Industries** received an $8,000 grant from the Chelsea Center for Recycling and Economic Development to test the "Cold Patch" pothole paving material that uses the plastic from shredded computer housings as a feedstock rather than the more traditional rock aggregate. The use of the recycled material represents a partial solution to the problem of disposing of the growing number of discarded computers and electronic equipment.

The support provided by the Chelsea Center allowed Conigliaro Industries to evaluate various mixes of materials for Cold Patch to ensure the best possible performance under standard road conditions as well as hot and cold weather extremes. The resulting product is a light-weight, quick-curing formulation that withstands severe weather conditions, according to Greg Conigliaro, president of Conigliaro Industries. "Without the Chelsea Center's help, we probably would not have taken on the Cold Patch project," Conigliaro says. "Small companies are the source of the innovation, but they don't always have the resources to do the testing," he notes. "I call the Chelsea Center all the time asking questions, and they respond." In addition to receiving the testing grant from the Chelsea Center, Conigliaro Industries received a $45,000 grant from DEP to ramp up production of the Cold Patch product and a $110,000 grant from the American Plastics Council to purchase the equipment needed for grinding the plastic computer housings.

Product Testing and Verification

Testing the Compatibility of Recycled Materials with Product Colors

The Chelsea Center worked with **Recycline** to test new colors for the company's Preserve toothbrush, which is made from recycled plastics. "One of the challenges we face is to source different recycled materials, which can react differently with the various colorants we use," according to Recycline President Eric Hudson. "With the Chelsea Center's help, we conducted tests to ensure that the mix of materials we chose is compatible with the colors we wanted," Hudson notes. As a result, "we were able to roll out some lighter colors last fall, and received a great reaction in the marketplace." The Chelsea Center also helped Recycline test a new Preserve toothbrush for children and bring it from the research level to a prototype for which the company is now making the molds.

While the Preserve toothbrush is Recycline's principal product line, the company is also developing the Ultra Slide scuff board, which protects the interior walls of tractor trailers from damage by fork lifts. While current scuffboards are made of oak, the Ultra Slide uses compounds of recycled plastic. Working with funds from the Chelsea Center and guidance provided by Professor Robert Malloy at UMass-Lowell, Recycline tested various processes for producing the plastic composites. The test results showed that Recycline can dramatically improve the efficiency of the process and reduce its cost. Recycline is scheduled to deliver prototype Ultra Slide products to customers in early 2000.

Providing On-Site Assistance to Solve Production Problems

SelecTech took advantage of the Chelsea Center's ReTERN program to solve a problem in achieving the desired performance from the blend in one of the company's flooring tile products. SelecTech makes a variety of injection-molded products, including flooring materials, planters, and plastic lumber products, from difficult-to-recycle materials such as carpet waste and mixed plastics. Under the ReTERN program, Chelsea Center interns assist companies in addressing various types of technical and business challenges. For SelecTech, intern Ming Lu identified a nonuniform mixture of carpet waste and recycled polyvinyl chloride (PVC) as the source of the blending problem in the flooring product, and then solved the problem by conducting a series of tests to determine the optimum amount of mixing required.

During 1999, the Chelsea Center also conducted in-depth testing of SelecTech's plastic lumber to assess a variety of performance factors, such as strength, durability, and resistance to sunlight. "Our timber product looks like a big Lego block, and at first glance, people wonder if it is strong enough," according to SelecTech President Tom Ricciardelli. The results of the Chelsea Center testing "were very positive," he notes. "In general, we tap STEP whenever we can," he adds.

Commercialization Assistance

The STEP partners offer assistance in evaluating the commercial potential for technologies that are still in the earliest stages of development. In addition, STEP assists companies in developing and refining business plans and arranging meetings with potential strategic partners, possible customers, and promising sources of financing.

"The STEP review of our business plan was critical to developing a winning proposal for securing investors."

John Gannon
President & Chief Executive Officer
CASTion

Securing Financing through Better Business Strategies

During 1999, **AWT Environmental, Inc. (New Bedford)** received $250,000 in financing from the Massachusetts Community Development Finance Corp.'s Venture Capital Fund after receiving financial advice from UMass-Boston's Environmental Business and Technology Center (EBTC). A key element of EBTC's assistance was the review of AWT's business plan. "That critique was extremely good," says Craig Lindell, AWT's president and founding principal. "With it, we went back and rewrote the business plan, and received good comments." One recommendation from the EBTC's critique of AWT's business plan was a suggestion that the company change its name to clearly reflect its focus on the water industry. During 2000, the company will change its name to Aquapoint, according to Lindell.

Helping Firms Find Customers and New Financing

CASTion (Ludlow) has continued to receive STEP assistance long after the company's first contact with the program. The relationship began with STEP's evaluation of the CAST wastewater recovery system, which is based on a flash-vacuum distillation process. "The resulting report, which validated the technology and our claims of purity level and economic operation, was absolutely instrumental in helping us win our first customers," according to John Gannon, CASTion's president and chief executive officer. CASTion now has over 25 CAST systems installed, treating more than 40-million gallons of wastewater per year. During 1999, CASTion received assistance from EBTC in reviewing the company's business plan and preparing it for another round of investment, according to Gannon. As a result of STEP's assistance, CASTion received $1.5 million in new equity financing from Mountain Energy, a wholly owned subsidiary of Green Mountain Power in Burlington, Vermont. "The STEP review of our business plan was critical to developing a winning proposal for securing investors," says Gannon.

Organizing Networking Events for STEP Companies

To assist the growing number of Massachusetts companies seeking capital, EBTC sponsored a series of networking events in 2000, including the Environmental Capital Forum and the Raising Capital Seminar. These events succeeded in introducing over 40 individual investors and corporate investors to other investors and to the management of 14 promising companies in Massachusetts that are involved in commercializing innovative technologies with energy, industrial process, and environmental applications.

Companies that Received STEP Assistance during 1999-2000

AAA Laser Service and Supply (Somerville)
Advanced Electron Beam (Winchester)
Aerodyne Research (Billerica)
AlliedSignal (Morristown, NJ)
Alpha Metals (Derry, NH)
Altron (Wilmington)
Alza (Mountain View, CA)
American Adhesive Coating (Lawrence)
Amoco Chemicals (Naperville, IL)
Aqua Terra Area (Cleveland, OH)
AquaFuture (Turners Falls)
Applied Recovery Technology (Beverly)
Architectural Timber and Millwork (Hadley)
Arlin Manufacturing (Lowell)
Ascension Technologies (Waltham)
Asian Community Development Corp. (Boston)
Atlantic Orient (Norwich, VT)
AWT Environmental (New Bedford)
B&D Aquatics (New Bedford)
Bay State Envelope (Mansfield)
Bay State Paper (Hyde Park)
Biocorp (Redondo Beach, CA)
Biofine (Waltham)
BP (Houston, TX)
BTU International (Billerica)
CASTion (Ludlow)
Center for Ecological Technology (Pittsfield)
CeraMem (Waltham)
Chand Kare Technical Ceramics (Worcester)
ChemMotif (Concord)
Clean Air Technologies (Natick)
Conigliaro Industries (Framingham)
C.R. Bard (Murray Hill, NJ)
Creative Paper (Worcester)
Crispina Designs (Housatonic)
Crystal Water Systems (Chestnut Hill)
Daicel (Tokyo, Japan)
Dorchester Industries (Leyden)
Dow Chemical (Freeport, TX)
DuBois Chemical (Providence, RI)
E Paint (East Falmouth)
Earth Safe (Marston Mills)
Eastman Kodak (Rochester, NY)
East-West Education Development Foundation (Boston)
ECC (Holden)
ElectroChem (Woburn)
ELM Environmental (Holbrook)
Energy Transition Technology (North Andover)
Engelhard (Iselin, NJ)
Environmental Printing Alternatives (Worcester)
ERC Wiping Products (Lynn)
Erickson Materials (Woburn)
Erving Paper Industries (Erving)
F&B Enterprises (New Bedford)
Foster Miller (Waltham)
GE Plastics (Pittsfield)
General Motors (Detroit, MI)
GM Refrigeration (Fall River)
Green Leaf Composting (Jamaica Plain)
Green Star Development (Medford)
Guardian Environmental Technologies (Kent, CT)
Hadco (Haverhill)
Happily Ever After (Centerville)
HIL Technology (Portland, ME)
ICET (Norwood)
Indigo Glass (Montague)
Indium Corporation of America (Utica, NY)
Ion Signature Technology (Cambridge)
JMC Environmental Systems (West Concord)
LaCerta Group (Boston)
Landis Gardner (Waynesboro, PA)
Laser Two (Burlington)
Lasertone (Wayland)
Loctite (Rocky Hill, CT)
Longleaf Lumber (Somerville)
Markem (Keene, NH)
MicroMag (Framingham)
Millipore (Bedford)
Mitsubishi Chemicals (Japan)
Molecular Technologies (Westford)
Morton International (Chicago, IL)
Multicore Solders (Hemel Hempstead, U.K.)
National Fiber Insulation (Belchertown)
New Horizon Management and Consulting (Papilon, NE)
Norton Co. (Worcester)
Oracle (Boston)
Osmos International (Lowell)
Parlex (Methuen)
Paradise City Glassworks (Florence)
Physical Sciences, Inc. (North Andover)
Polaroid Corp. (Cambridge)
Praxair (Tarrytown, NY)
Presstek (Hudson, NH)
Printed Circuit (Woburn)
Prosys (North Billerica)
Pure Cycle Environmental Technologies (Palmer)
Quabaug (North Brookfield)
Red Sun Press (Boston)
Recycline (Somerville)
ReEnergy (San Francisco, CA)
Rexam Image Products (South Hadley)
Sammina (Wilmington)
Second Wind (Somerville)
SelecTech (Taunton)
Shell Chemical (Houston, TX)
Simulprobe (Mill Valley, CA)
Sippican (Marion)
SKF Technical Development Center (Goteborg, Sweden)
Solectron (Andover)
SolmeteX (Billerica)
Solutia (Springfield)
Supply Solutions (Winchester)
Taunton Municipal Lighting Plant (Taunton)
Teradyne (Boston)
3M (St. Paul, MN)
Torrington (Torrington, CT)
U.S. Army - Natick and Aberdeen Research Labs (Natick)
Walden Products (Concord)
Water & Energy Systems (Atkinson, NH)
Vortechnics (Portland, ME)
Zero Discharge Technologies (Chicopee)

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STEP Companies in Massachusetts

S T E P

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